Description

Dual-configuration receiver

The invention relates to a method for receiving first signals and further signals using a receiver

Such methods and receivers are used, for example, in automotive technology in order to receive, with the minimum possible complexity and cost, radio applications in the vehicle having different transmission parameters.

For example, radio applications such as a "keyless or contactless remote-control entry system", usually referred to as RKE (remote keyless entry), and tire-pressure monitoring, usually referred to as Tire Guard, are implemented in the vehicle with different transmission parameters because of different physical conditions and requirements (different range, information content, etc.).

In this case, the differences in the transmission parameters mostly lie in the data rates used and/or the modulation techniques used (amplitude, frequency, phase modulation ASK/FSK/PSK) for transmitting signals.

In principle, the signals from the different radio applications can obviously differ in any transmission parameters such as data rate, modulation type, wake-up criterion, synchronization and threshold value etc.

Solutions known in vehicular technology try to receive and determine a transmission parameter in which the applications differ, and, on successful determination, to switch the receiver into the relevant mode for further receiving.

Disadvantageously, the receiver for determining the transmission parameter is not optimally configured for at least one of the two applications, which introduces performance compromises. For example, if, for different data rates, the data-filter bandwidth is selected to suit the higher data rate, then the receiver is not

optimally configured for receiving lower data-rate signals, and corresponding performance losses must be reckoned with.

Furthermore, this method is also highly application specific, which is why a microcontroller is needed to determine the transmission parameter and to then switch over the receiver into the relevant mode. This, however, has the disadvantage of causing an unwanted rise in the quiescent current.

In addition, patent DE 101 07 130 A1 discloses a super-regenerative receiver that requires no application-matched input circuit and that can demodulate the ASK and FSK signals. This receiver has a complex circuit design, however, and has an increased quiescent current consumption because of its quench-controlled sweep circuit.

Thus the object of the present invention is to create a method for receiving first signals and further signals using just one receiver, and a receiver for carrying out such a method that guarantees optimum reception of the first and further signals in a simple and cost-effective way with low quiescent current consumption.

This object is achieved according to the invention by a method having the features of claim 1, and by a receiver having the features of claim 6.

According to the invention, configurations are saved in the receiver, whereby the receiver can be switched (over) into a given receive mode by setting, calling or loading a relevant configuration. After start-up with a first configuration, the receiver attempts to receive signals using this configuration and to search for a suitable wake-up criterion respectively.

If the signal-reception and/or search remains unsuccessful, the receiver switches over into a different receive mode, for example by calling a different configuration from a memory unit, and tries again to receive signals having these transmission parameters (as given by the configuration) and to search for a suitable (different) wake-up criterion respectively.

In this process, the switchover can occur at the receiver end as a result of the technical design (unsuccessful cycle through the "synchronization" and/or "search for wake-up criterion" states) or after the expiry of a time interval preset by hardware or software (timer, RC-element, counter etc.).

If the reception of signals and/or the search for a suitable wake-up criterion remains unsuccessful, the receiver can be switched over as many times as there are configurations.

Of course, the time intervals for different configurations need not be identical, but can also be included in the configuration as parameters. In addition, it is conceivable that configurations are not called consecutively in a fixed sequence just once in each case, but in any pre-definable sequence and number, or repetition, within a cycle.

In a preferred embodiment according to the invention, after an unsuccessful cycle, a new cycle can be started, beginning with the first configuration.

Since a microcontroller is not needed to implement this method, these cycles can be repeated without limit in a quiescent mode, because the quiescent-current consumption of the method according to the invention is extremely low.

In a further embodiment of the invention, on receiving successfully using a certain configuration and finding a suitable wake-up criterion, a wake-up signal can be output that contains as information the given configuration for the successful reception. This output signal can be used, for example, to switch the receiver or other devices into an active mode, and to continue the further data transmission using the optimum configuration, possibly also bi-directionally.

Further advantageous embodiments of the invention follow from the dependent claims.

The invention is explained in more detail below with reference to an exemplary embodiment shown in the drawing.

In the drawing,

Fig. 1 shows a flow diagram for the method according to the invention.

The flow diagram shown in figure 1 explains how the method according to the invention or a receiver according to the invention works from the example of a receiver that is designed for receiving two different signals, for example RKE and Tire Guard. In this case, the RKE signal differs from the Tire-Guard signal at least by a lower data rate of 1 to 2 kbits per second, for example, compared with the Tire-Guard signal having a data rate of 9.6 kbits per second.

If the receiver is in a quiescent mode 1, in which it is preferably receiving for a short time in intervals, then the receiver attempts to receive using configuration A as per step 3, whereby the configuration can contain transmission parameters such as data rate, modulation type, wake-up criterion, synchronization, time information etc.

If the receiver receives a signal using configuration A, it attempts to synchronize itself in order to decode the information contained in the signal, and possibly also (where no threshold value has been set as a parameter in the configuration) to set a threshold value depending on the signal as per step 5.

If, based on configuration A, a wake-up criterion can be found in the signal or in the information it contains as per step 7, then the receiver using the configuration A goes into an active mode as per step 15. Here a wake-up signal can be output additionally, in order to switch other devices such as control devices in the vehicle into an active mode via an interrupt request IRQ at output 17, for example.

If, on the other hand, the search for a wake-up criterion based on configuration A remains unsuccessful, the receiver switches to a configuration B as per step 9, and tries to receive a signal using this configuration having at least one changed transmission parameter, for example a different modulation type and/or different data rate.

If a suitable signal is detected, the receiver attempts to synchronize itself as per step 11, and possibly to set a suitable threshold value.

If the signal or the information contained in it contains a wake-up criterion based on configuration B, then the receiver using configuration B goes into an active mode as per step 15, and possibly additionally outputs at output 19 a wake-up signal, for example as interrupt request IRQ, which advantageously also contains the information on the successful receiving configuration, namely B.

If, on the other hand, such a wake-up criterion based on configuration B is not found, the receiver starts again from the beginning, that is with reception using the configuration A, or rather switches back to configuration A.

This method according to the invention, which is described above with reference to the flow diagram, can be implemented by a "self-polling" function without using a microcontroller, so that a minimum possible quiescent current consumption is guaranteed.

Of course, the invention is not limited to the exemplary embodiment shown employing serial polling of the two (radio) applications using two configurations A and B designed to match these applications, but can be expanded to self-polling for a plurality of configurations or a plurality of transmission channels.

Here the configurations can be stored in a storage device, for example a register, permanent memory L, memory card etc., and read out from this again advantageously without using a microprocessor.

In each case, the method according to the invention provides optimum performance for each of the radio applications to be received, in particular an optimum sensitivity, and is hence more precise and possibly faster than determining a specific transmission parameter without an optimum configuration.

Priority

[0001] This application claims foreign priority of the German application DE 102 53 933.2 filed on November 19, 2002.

Technical Field

[0002] The invention relates to a method for receiving first signals and further signals using a receiver.

Background of the Invention

[0003] Such methods and receivers are used, for example, in automotive technology in order to receive, with the minimum possible complexity and cost, radio applications in the vehicle having different transmission parameters.

[0004] For example, radio applications such as a "keyless or contactless remote-control entry system", usually referred to as RKE (remote keyless entry), and tire-pressure monitoring, usually referred to as Tire Guard, are implemented in the vehicle with different transmission parameters because of different physical conditions and requirements (different range, information content, etc.).

[0005] In this case, the differences in the transmission parameters mostly lie in the data rates used and/or the modulation techniques used (amplitude, frequency, phase modulation ASK/FSK/PSK) for transmitting signals.

[0006] In principle, the signals from the different radio applications can obviously differ in any transmission parameters such as data rate, modulation type, wake-up criterion, synchronization and threshold value etc.

[0007] Solutions known in vehicular technology try to receive and determine a transmission parameter in which the applications differ, and, on successful determination, to switch the receiver into the relevant mode for further receiving.

[0008] Disadvantageously, the receiver for determining the transmission parameter is not optimally configured for at least one of the two applications, which introduces performance compromises. For example, if, for different data rates, the data-filter bandwidth is selected to suit the higher data rate, then the receiver is not optimally configured for receiving lower data-rate signals, and corresponding performance losses must be reckoned with.

[0009] Furthermore, this method is also highly application specific, which is why a microcontroller is needed to determine the transmission parameter and to then switch over the receiver into the relevant mode. This, however, has the disadvantage of causing an unwanted rise in the quiescent current.

[0010] In addition, patent DE 101 07 130 A1 discloses a super-regenerative receiver that requires no application-matched input circuit and that can demodulate the ASK and FSK signals. This receiver has a complex circuit design, however, and has an increased quiescent current consumption because of its quench-controlled sweep circuit.

Summary of the Invention

[0011] Thus the object of the present invention is to create a method for receiving first signals and further signals using just one receiver, and a receiver for carrying out such a method that guarantees optimum reception of the first and further signals in a simple and cost-effective way with low quiescent current consumption.

[0012] According to the invention, configurations are saved in the receiver, whereby the receiver can be switched (over) into a given receive mode by setting, calling or loading a relevant configuration. After start-up with a first configuration, the receiver attempts to receive signals using this configuration and to search for a suitable wake-up criterion respectively.

[0013] If the signal-reception and/or search remains unsuccessful, the receiver switches over into a different receive mode, for example by calling a different

configuration from a memory unit, and tries again to receive signals having these transmission parameters (as given by the configuration) and to search for a suitable (different) wake-up criterion respectively.

[0014] In this process, the switchover can occur at the receiver end as a result of the technical design (unsuccessful cycle through the "synchronization" and/or "search for wake-up criterion" states) or after the expiry of a time interval preset by hardware or software (timer, RC-element, counter etc.).

[0015] If the reception of signals and/or the search for a suitable wake-up criterion remains unsuccessful, the receiver can be switched over as many times as there are configurations.

[0016] Of course, the time intervals for different configurations need not be identical, but can also be included in the configuration as parameters. In addition, it is conceivable that configurations are not called consecutively in a fixed sequence just once in each case, but in any pre-definable sequence and number, or repetition, within a cycle.

[0017] In a preferred embodiment according to the invention, after an unsuccessful cycle, a new cycle can be started, beginning with the first configuration.

[0018] Since a microcontroller is not needed to implement this method, these cycles can be repeated without limit in a quiescent mode, because the quiescent-current consumption of the method according to the invention is extremely low.

[0019] In a further embodiment of the invention, on receiving successfully using a certain configuration and finding a suitable wake-up criterion, a wake-up signal can be output that contains as information the given configuration for the successful reception. This output signal can be used, for example, to switch the receiver or other devices into an active mode, and to continue the further data transmission using the optimum configuration, possibly also bi-directionally.

Brief Description of the Drawings

[0020] The invention is explained in more detail below with reference to an exemplary embodiment shown in the drawing.

[0021] In the drawing,

[0022] **Fig.** 1 shows a flow diagram for the method according to the invention.

Detailed Description of the Preferred Embodiments

[0023] The flow diagram shown in figure 1 explains how the method according to the invention or a receiver according to the invention works from the example of a receiver that is designed for receiving two different signals, for example RKE and Tire Guard. In this case, the RKE signal differs from the Tire-Guard signal at least by a lower data rate of 1 to 2 kbits per second, for example, compared with the Tire-Guard signal having a data rate of 9.6 kbits per second.

[0024] If the receiver is in a quiescent mode 1, in which it is preferably receiving for a short time in intervals, then the receiver attempts to receive using configuration A as per step 3, whereby the configuration can contain transmission parameters such as data rate, modulation type, wake-up criterion, synchronization, time information etc.

[0025] If the receiver receives a signal using configuration A, it attempts to synchronize itself in order to decode the information contained in the signal, and possibly also (where no threshold value has been set as a parameter in the configuration) to set a threshold value depending on the signal as per step 5.

[0026] If, based on configuration A, a wake-up criterion can be found in the signal or in the information it contains as per step 7, then the receiver using the configuration A goes into an active mode as per step 15. Here a wake-up signal can be

output additionally, in order to switch other devices such as control devices in the vehicle into an active mode via an interrupt request IRQ at output 17, for example.

[0027] If, on the other hand, the search for a wake-up criterion based on configuration A remains unsuccessful, the receiver switches to a configuration B as per step 9, and tries to receive a signal using this configuration having at least one changed transmission parameter, for example a different modulation type and/or different data rate.

[0028] If a suitable signal is detected, the receiver attempts to synchronize itself as per step 11, and possibly to set a suitable threshold value.

[0029] If the signal or the information contained in it contains a wake-up criterion based on configuration B, then the receiver using configuration B goes into an active mode as per step 15, and possibly additionally outputs at output 19 a wake-up signal, for example as interrupt request IRQ, which advantageously also contains the information on the successful receiving configuration, namely B.

[0030] If, on the other hand, such a wake-up criterion based on configuration B is not found, the receiver starts again from the beginning, that is with reception using the configuration A, or rather switches back to configuration A.

[0031] This method according to the invention, which is described above with reference to the flow diagram, can be implemented by a "self-polling" function without using a microcontroller, so that a minimum possible quiescent current consumption is guaranteed.

[0032] Of course, the invention is not limited to the exemplary embodiment shown employing serial polling of the two (radio) applications using two configurations A and B designed to match these applications, but can be expanded to self-polling for a plurality of configurations or a plurality of transmission channels.

[0033] Here the configurations can be stored in a storage device, for example a register, permanent memory L, memory card etc., and read out from this again advantageously without using a microprocessor.

[0034] In each case, the method according to the invention provides optimum performance for each of the radio applications to be received, in particular an optimum sensitivity, and is hence more precise and possibly faster than determining a specific transmission parameter without an optimum configuration.